Bidirectional Dual Active Bridge Power Converter for Spacecraft Power Systems, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

A bidirectional dual active bridge (DAB) dc-dc converter for electrical power systems (EPS) is proposed. The converter operates as a charger, upconverter, and downconverter using a single transformer. The converter uses smart technology to interleave DAB converter stages for ripple current reduction and optimized load sharing of stages to extend the high efficiency load range of the converter to 6.25% of full load. By using smart technology, the load condition of each DAB converter stage is monitored and its load sharing controlled depending on the converters total load condition. In this way, each converter stage is kept at or above 25% load. Therefore the minimum load of the new DAB converter with four interleaved stages is one fourth of 25% or 6.25%. The design employs radiation-resistant and cryogenic-temperature-capable GaN HEMT devices to process 2 kW of power per stage. Mainstream has tested GaN HEMT devices to -225 ^{0}C. GS66508T GaN HEMT devices are rated for 650 VDC maximum drain-to-source maximum voltage stress allowing for a maximum steady-operating voltage of 400 VDC at 60% derating.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Many NASA applications can benefit from incorporating the DAB converter into their electrical power systems. Spacecraft power systems can manage power sources with fewer power supplies. To charge on-board batteries and provide the high-voltage DC bus for motor inverters, the power systems of NASA electric vehicles, such as the Modular Robotic Vehicle and unmanned aerial vehicles, such as the Predator B, need compact, low-volume, low-mass dc-dc converters. The converter must also be bidirectional and multifunctional.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Military vehicle,

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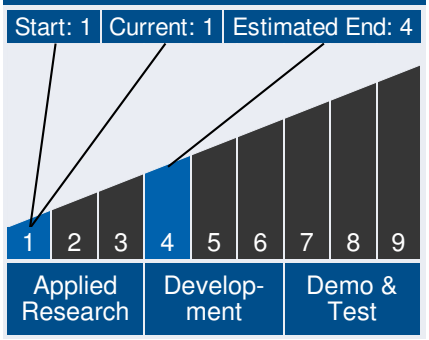
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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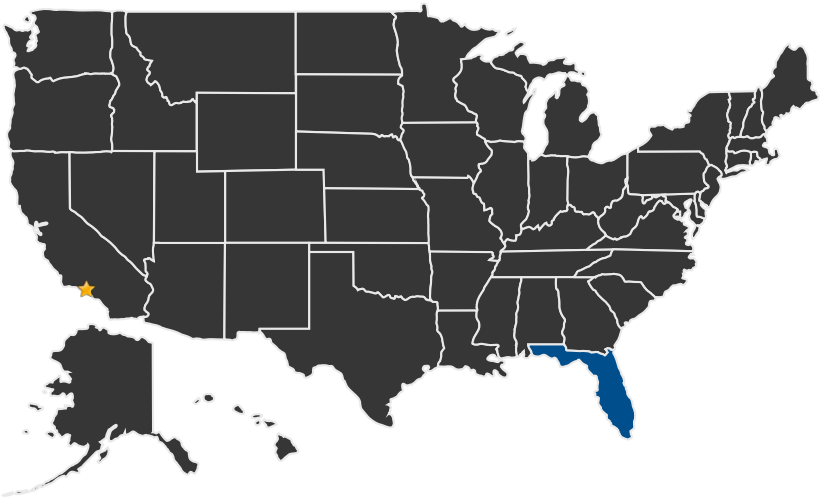
and helicopter starter-generator power systems also necessitate the use of small, compact, dc-dc converters. These applications also operate in extremely low temperature conditions of less than -55 ^{0}C in artic, high elevation, and cold, high-altitude, environments. Therefore the DAB converter is an optimal solution for these applications.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Jet Propulsion Laboratory

Other Organizations Performing Work:

- Mainstream Engineering Corporation (Rockledge, FL)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23477)

Management Team *(cont.)*

Principal Investigator:

- Troy Beechner

Technology Areas

Primary Technology Area:
Space Power and Energy Storage (TA 3)
└ Power Management and Distribution (TA 3.3)
  └ Management and Control (TA 3.3.2)

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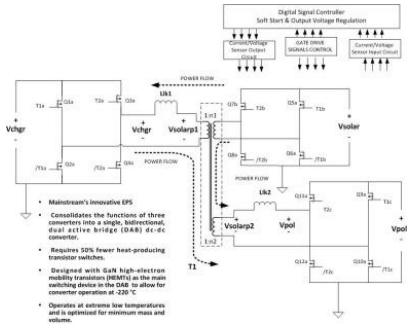
IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

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